ENGLISH TRANSLATION

OF INTERNATIONAL APPLICATION

PCT/EP02/03165

12) INTERNATIONAL APPLICATION PUBLISHED IN ACCORDANCE WITH THE PATENT CO-OPERATION TREATY (PCT)

(19)World Intellectual Property Organization
International Office

[WIPO logo]

PCT

[bar code]

(43) Date of International Publication:
October 3, 2002 (10/03/2002)

(10) International Publication Number:
WO 02/076807 A1

(51) International Patent Classification[7]:
B62D 5/04, 1/04

(21) International Appl. No.: PCT / EP02 / 03165

(22) Filed:
March 21, 2002 (03/21/2002)

(25) Language submitted in:
German

(26) Language published in:
German

(30) Priority Data
101 14 687.6 March 23, 2001 (03/23/2001) DE

(71) Applicants *(for all designated states except the US)*:
LEOPOLD KOSTAL GMBH & CO.KG [DE/DE]; Wiesenstra. 47, 58507 Lüdenscheid (DE).

(72) Inventors; and
(75) Inventors/Applicants *(only for US)*:
HIRSCHFELD, Klaus [DE-DE]; Gustavstr. 15, 58511 Lüdenscheid (DE). **BLÄSING; Frank** [DE/DE]; Kurze Str. 15, 59457 Werl (DE). **DEITMERG, Martin** [DE/DE]; Oberer Worthagen 60, 58507 Lüdenscheid (DE). **LETTMANN, Holger** [DE/DE]; Recihsstra. 50, 58840 Plettenberg (DE). **BÖBEL, Ralf** [DE/DE]; Ostkirchstr. 99, 44269 Dortmund (DE). **MENZ, Rüdiger** [DE/DE]; Mooskampweg 16, 58644 Iserlohn (DE). **NIEDING, Klaus** [DE/DE]: Kölner Str. 9, 58553 Halver (DE)-

(54) Title: STEERING WHEEL FOR A MOTOR VEHICLE

(57) Abstract: The invention relates to a steering wheel for a motor vehicle comprising a steering wheel module (1), which supports electrical/electronic subassemblies and which is attached to the steering wheel (13). The steering wheel is characterized in that part of the steering wheel module (1) is the torsion module (8) of a torque detection device of a steering power-assist system or of a steering system via which the steering wheel module (1) that can be inserted from the front into the center (15) of the steering wheel (13) is attached to the steering wheel (13), and the steering wheel (13) itself can thus be joined to the steering spindle of a steering column via the torsion module (8).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FL, GB, GD, GE, GH, GM, HR, HÜ, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE,).

Published

? *With an international research report*

? *Before the deadline which applies for changes to claims; will be republished if changes are made.*

For explanation of the two-letter codes and other abbreviations, please see the section entitled ?Guidance Notes on Codes and Abbreviations? at the beginning of every regular edition of the PCT gazette.

Steering Wh l for a Motor Vehicle

The invention relates to a steering wheel for a motor vehicle comprising a steering wheel module, which supports electrical/electronic subassemblies and which is attached to the steering wheel.

Among other things, motor vehicle steering wheels comprise electrical/electronic subassemblies such as switches, display instruments and/or an airbag device. In general, these subassemblies are assembled individually and independently of one another in or on the steering wheel or steering wheel spokes. To simplify assembly of the electrical/electronic subassemblies, especially the control element, it has already been suggested to arrange them jointly on a base support so that they can be jointly attached to the steering wheel. Such a previously kown steering wheel module will, as a rule, be attached to the steering wheel from the steering wheel pressure side.

Electrical steering power-assist systems are being used to an increasing extent in motor vehicles. For these systems, the torque exerted on the steering wheel is necessary as the reference value so that using the detected torque, the desired steering power-assist can take place. In order to measure the torque, a torsion module is needed that allows an angular offset between the steering wheel and the steering spindle when a torque is applied. Such proposals are, for example, familiar from DE 197 55 044 C1 or WO 99/40402 A1. In the case of the items in these documents, the torsion module is assembled between the steering wheel and the steering spindle, separate from the steering wheel and also separate from the electrical/electronic subassemblies attached to the steering wheel. Accordingly, the torsion module or the mechanisms for detecting the rotational offset must be assembled separately and electrically connected. For this reason, a comprehensive functionality test of the steering wheel, including the torque detection device, cannot be performed until the necessary subassemblies have been assembled in the motor vehicle. In general, this is possible, but it means that this functionality test has to be performed by the vehicle manufacturer.

Based on the prior art discussed above, the purpose of this invention is to enhance a steering wheel as described at the outset with a steering wheel module that enables a comprehensive functionality test of the electrical/electronic subassemblies mounted in the steering wheel, including the torque detection device for a steering power-assist system, to be performed prior to assembly of the steering wheel on the steering spindle of a steering column so that a functionality test of the electrical/electronic subassemblies attached to the steering wheel, including the torque detection device, is no longer necessary after assembly of this unit in the motor vehicle has been completed.

This object is achieved, according to the present invention, in that part of the steering wheel module is the torsion module of a torque detection device of a steering power-assist system or of a steering system through which the steering wheel module that can be inserted from the front into the center of the steering wheel is attached to the steering wheel, and the steering wheel itself can thus be joined to the steering spindle of a steering column via the torsion module.

In contrast to the known prior art, in the case of the steering wheel according to invention, part of the steering wheel module is the torsion module of a *torque detection device*. The steering wheel module is attached to the steering wheel via the torsion module so that in this way the steering wheel itself is able to be joined to the steering

spindle of a steering column via the torsion module. Furthermore, the steering wheel module can be inserted from the front into the center of the steering wheel so that the steering wheel module can be assembled as a whole, including its torsion module, on the steering wheel in one step. Prior to its assembly on the steering wheel, the steering wheel module is suitably tested with regard to the functionality of its components so that such a functionality test is basically no longer necessary at a later time. Assembly of a steering wheel module, already tested for functionality, to the steering wheel can be performed by both the steering wheel manufacturer as well as the motor vehicle manufacturer without affecting the previous functionality test since the electrical/electronic subassemblies already combined in the steering wheel module, including the torsion module, no longer have to be disassembled again. After attaching the steering wheel module along with its torsion module to the steering wheel, the torsion module and therefore the steering wheel with steering wheel module can be subsequently attached to the steering spindle.

In a preferred embodiment, the torsion module is designed to be shaped like a type of spoke wheel whose hub piece can be joined so that it does not rotate with respect to the steering spindle. Stretching out radially from the hub piece are a plurality of flexible spokes that join the hub piece to a rim that concentrically surrounds the hub piece. The flexible spokes are suitably equipped with strain gauges via which it is possible to detect the amount of flexing, which is dependent on the applied torque. In order to limit the possible amount of flexing of the flexible spokes due to an offset resulting from an applied torque between the hub piece and the rim, it is useful to arrange limit stop spokes alternately with the flexible spokes such that these limit stop spokes are attached so that they do not rotate with respect to the hub piece, and engage a limit stop arrangement on the rim with each of their free ends. The limit stop arrangement can be constructed, for example, of two beads distanced from one another. The amount of flexing of the flexible spokes can be detected using so-called strain gauges that are affixed on the outside of the flexible spokes. In one such case it is useful to have limit stop spokes engage a limit stop arrangement which also limits relative movement of the rim to the hub piece in an axial direction. The purpose of these limit stops that operate in an axial direction is to prevent bending of the flexible spokes in an axial direction in order to counteract faulty interpretations caused by bending of a flexible spoke.

Part of the steering wheel module can also be an airbag device which with regard to its pre-tested functionality can be likewise assembled on the steering wheel or in the motor vehicle. In case such an airbag device is part of the pre-tested steering wheel module, it is useful to attach the torsion module with the mounted steering wheel module and the steering wheel to the steering spindle using a radial-acting means of fastening. Alternatively, axial fastening to the steering spindle can also be provided.

Below is a description of the invention using a preferred embodiment with reference to the enclosed drawings. It shows:

Fig. 1: A steering wheel module for the steering wheel of a motor vehicle in the nature of an exploded view and

Fig. 2: A diagonal view of the steering wheel module inserted in a steering wheel of Figure 1 in the nature of an exploded view.

Steering wheel module 1 for outfitting a motor vehicle comprises base support 2 with casing 3 and, from casing 3 to the upward projecting brackets 4, 5 on which the holders for the electrical switches or switch configurations located on top are arranged. Brackets 4, 5 are set up so that the subassemblies to be operated and supported by them are arranged next to the airbag cover of a steering wheel. Inserted in casing 3A is circuit board 6, among others, with the power electronics necessary for operating the electrical/electronic subassemblies of brackets 4, 5. Casing 5 is connected underneath by bottom cover 7. The lower end of steering wheel module 1 forms a spoke wheel 8, which is separated from bottom cover 7 by spacer ring 9, and is used as a torsion module for a torque detection device. The spoke wheel 8 comprises four flexible spokes which join hub piece 10 of spoke wheel 8 with rim 11 that concentrically surrounds hub piece 10. Hub piece 10 has a multi-grooved mounting channel 12 which serves as the holder for the free end of a steering spindle of a steering column. Via hub piece 10, spoke wheel 8 is joined so that it cannot rotate with respect to the steering spindle. Alternating with flexible spokes B, additional limit stop spokes A1, each of whose free ends engage a limit stop arrangement made up of two respective beads W_1, W_2, extend in a radial direction from hub piece 10. Limit stop spokes A serve to limit the maximum angular offset between rim 11 and hub piece 10. Though not shown in the illustration, each of the respective flexible spokes B are equipped with strain gauges that detect the amount of flexing and thus a relative angle of rotation offset between rim 11 and hub piece 10. The strain gauges are connected to an analysis device that is also part of steering wheel module 1.

In the area of its regions adjacent to the limit stop arrangements formed by the beads W_1, W_2, the spacer ring 9 has inwardly pointing projections V that are each adjacent to the upper side of the beads W_1, W_2, and cover the limit stop gap formed by the beads W_1, W_2. The free end of the limit stop spokes A is also correspondingly guided on the bottom, either by another disk corresponding to spacer ring 9 or another component, for example, the base plate of a steering wheel. Due to the free ends of the limit stop spokes A being guided, a relative movement between hub piece 10 and rim 11 in the axial direction is hindered, so that when exerting such forces on spoke wheel 8 flexible spokes B are not bent. This serves to prevent faulty interpretations by the strain gauges affixed to one of the flexible spokes B which could result from a bending of a flexible spoke in an axial direction.

All components of the steering wheel module - base support 2, circuit board 6, bottom cover 7, spacer ring 9 and the spoke wheel 8 have four holes aligned with one another so that these components can be joined together by the four attachment bolts. One of these four attachment axes is characterized in Figure 1 with the reference BA. In the embodiment illustrated, the attachment bolts pass through the individual components of the steering wheel module 1 and are fastened to the center of a steering wheel with its threads. Thus, spoke wheel 8 attached to steering wheel module 1 serves to couple the steering wheel to the steering spindle.

Assembled steering wheel 1 shown in Figure 2 is axially arranged and aligned to steering wheel 13 in which it is fastened in the center 15 of steering wheel 13. Steering wheel module 1 also holds the airbag unit not shown here, which is attached in assembled condition between the two brackets 4, 5 with the electric switches. The airbag unit is held between the individual switches of brackets 4, 5. A pushbutton switch is placed on each of the respective outer ends of brackets 4, 5 on which the bottom side of the airbag unit rests. These pushbutton switches serve as the hub piece

contacts because the horn is also included along with the airbag unit. Attaching the hub piece contacts to brackets 4, 5 is useful because this can then be directly connected electrically to the power electronics on circuit board 6. Center 15 is formed by circular recess 16 with central perforation 17 which hub piece 10 of steering wheel module 1 penetrates. Furthermore, the threaded holes for inserting the attachment bolts for assembling steering wheel module 1 to steering wheel 13 are identifiable. The top side of recess 16 lies on the bottom side of rim 11 of spoke wheel 8 so that the lower limit stop for the limit stop spokes A of the spoke wheel is represented by this area.

Reference Character List

1	Steering wheel module
2	Base support
3	Casing
4	Bracket
5	Bracket
6	Circuit board
7	Bottom cover
8	Spoke wheel
9	Spacer ring
10	Hub piece
11	Rim
12	Mounting channel
13	Steering wheel
14	
15	Center
16	Recess
17	Perforation
A	Limit stop spoke
B	Flexible spoke
BA	Attachment axis
V	Projection
W1, W2	Bead

Claims

1 Steering wheel for a motor vehicle with a steering wheel module (1) that supports electrical/electronic subassemblies and which is attached to the steering wheel (13) characterized in that part of the steering wheel module (1) is the torsion module (8) of a torque detection device of a steering power-assist system or of a steering system via which the steering wheel module (1) that can be inserted from the front into the center (15) of the steering wheel (13) is attached to the steering wheel (13), and the steering wheel (13) itself can thus be joined to the steering spindle of a steering column via the torsion module (8).

2 Steering wheel according to claim 1 **characterized in that** the torsion module is a spoke wheel (8) with hub piece (10) that can be joined to the steering spindle, which is joined to a rim (11) that concentrically surrounds the hub piece (10) through a plurality of flexible spokes (B).

3 Steering wheel according to claim 2 **characterized in that** attachment holes are formed in the rim (11) parallel to the axis of the hub piece (10) into which attachment bolts are inserted for attaching spoke wheel (8) to steering wheel module (1), on the one hand, and to the steering wheel (13) in the area of its center (15), on the other.

4 Steering wheel according to claim 2 or 3 **characterized in that** the spoke wheel (8) has limit stop spokes (A) that are arranged alternately with the flexible spokes (B), and are joined so that they cannot be rotated with respect to the hub piece (10), such that the free ends of each of these limit stop spokes point outwards from the hub piece (10) and engage limit stop arrangements located on the rim (11).

5 Steering wheel according to claim 4 **characterized in that** a limit stop arrangement is formed by two stop beads (W1, W2) in the rim, each of which points radially inwards.

6 Steering wheel according to one of claims 2 to 5 **characterized in that** the flexible spokes (B) of the spoke wheel (8) are equipped with strain gauges for the detection of torque.

7 Steering wheel according to claim 6 **characterized in that** the limit stop spokes (A) of the spoke wheel (8) are limited by stops in the axial direction in order to hinder relative movement between the hub piece (10) and the rim (11) in this direction.

8 Steering wheel according to claims 1 through 7 **characterized in that** the analysis device for evaluating the torque exerted on the steering wheel and detected by the torsion module (8) is part of the steering wheel module (1).

9 Steering wheel according to claims 1 through 8 **characterized in that** the airbag unit is part of the steering wheel module.